OIPE JC73
MAY 0 9 2005
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Shin TAKANEZAWA et al.
Serial No.: 10/773,220
Filed: February 9, 2004
For: METHOD FOR PREPARINF AN INSULATING RESIN COMPOSITION, INSULATING RESIN COMPOSITION, MULTILAYER WIRING BOARD AND PROCESS FOR PRODUCING THE SAME
Art Unit: 1712
Examiner: SELLERS, Robert E

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

DECLARATION UNDER 37 CFR 1.132

SIR:

I. I, Shin TAKANEZAWA, the first inventor of this case, declare and say as follows.

I am one of the joint inventors of the present U.S. Patent Application as identified above and understand the English language. I studied the Official Action dated January 7, 2005 received in said application.

In order to clarify that the present invention is not obvious over the invention of Tobisawa et al. (US Patent No. 6,486,242) in view of Japanese Patent No. 2000-256537 and Inagaki et al. (US Patent No. 5,837,155) along with Japanese Patent No. 2001-247657 and Japanese Patent No. 2002-348353, I have conducted comparative experiments as mentioned below under my supervision.

II. Comparative experiments

An object of the experiments is to show the superiority of the insulating resin composition according to the present invention to those that do not contain any carboxylic acid-modified acrylonitrile butadiene rubber in a form of particle.

Examples 2 and Comparative examples A

Test sample A was prepared and tested in analogy to the example 2 of the present application except Carboxylic acid-modified acrylonitrile butadiene rubber (in a form of linear NBR), XER-31 SK25 (manufactured by JSR Corporation) 5 parts by weight was used instead of Carboxylic acid-modified acrylonitrile butadiene rubber particles, XER-91SE-15 (manufactured by JSR Corporation) 5 parts by weight as the component (B).

The example 2 was prepared and tested as described in the specification of the present invention. Comparative example A was prepared and tested in analogous to the example 2 of the specification of the present invention. The detail of comparative example A is explained below.

Comparative Example A

(1) A glass cloth-base epoxy resin double-sided copper-clad laminate sheet (MCL-E-67, manufactured by Hitachi Chemical Co., Ltd.; having double-sided roughened foils on both surfaces; copper foil thickness: 18 μm; substrate thickness: 0.8 mm) was etched to prepare a circuit board having on one surface thereof a circuit pattern (hereinafter, referred to as "first circuit pattern").

(2) A varnish of an insulating resin composition having the formulation shown below was prepared. The varnish of an insulating resin composition was applied to a PET film, and

dried at 100ºC for 10 minutes to prepare a film roll having an insulating resin with a thickness of 50±3 μm. The film having an insulating resin was laminated using a batch-mode vacuum air-pressed laminator (MVLP-500, manufactured by Meiki Co., Ltd.) onto one surface of the above-prepared circuit board so that the insulating resin was in contact with the first circuit pattern.

· Biphenyl epoxy resin, NC3000S-H (manufactured by Nippon Kayaku Co., Ltd.)

82.8 Parts by weight

· Carboxylic acid-modified acrylonitrile butadiene rubber (linear NBR), XER-31 SK25(manufactured by JSR Corporation)

5 Parts by weight

· Triazine ring-containing cresol novolak phenolic resin, PHENOLITE EXB-9829 (manufactured by Dainippon Ink & Chemicals Incorporated; nitrogen content: 18%; hydroxyl equivalent: 151)

12.2 Parts by weight

· Phosphorus-containing compound, HCA-HQ (manufactured by SANKO CO., LTD.)

26 Parts by weight

· Inorganic filler, spherical silica, ADMAFINE SC-2050 (manufactured by Admatechs Co., Inc.)

40 Parts by weight

· Imidazole derivative compound, 1-cyanoethyl-2-phenylimidazolium trimellitate, 2PZ-CNS (manufactured by Shikoku Corporation)

0.24 Part by weight

· Solvent, methyl ethyl ketone

55 Parts by weight

(3) The PET film was peeled off the film having an insulating resin laminated onto the circuit board, and the insulating resin was cured under conditions for curing at 180ºC

for 60 minutes to form a first insulating layer.

(4) A hole for interlayer connection was formed in the first insulating layer using a CO_2 laser processing machine (model LCO-1B21, manufactured by Hitachi Via Mechanics, Ltd.) under conditions such that the beam diameter was 80 μm, the frequency was 500 Hz, the pulse width was 5 μsec, and the shot count was 7.

(5) The circuit board having a hole formed therein was immersed in a swelling solution (aqueous solution of diethylene glycol monobutyl ether: 200 ml/l, NaOH: 5 g/l) heated to 70ºC for 5 minutes, and subsequently immersed in a roughening solution (aqueous solution of $KMnO_4$: 60 g/l, NaOH: 40 g/l) heated to 80ºC for 10 minutes, and then immersed in a neutralization solution (aqueous solution of $SnCl_2$: 30 g/l, HCl: 300 ml/l) at room temperature for 5 minutes to effect neutralization, thus roughening the first insulating layer.

(6) For forming a second circuit pattern on the roughened surface of the first insulating layer, the circuit substrate was first immersed in a catalyst solution for electroless plating containing $PdCl_2$ (HS-202B, manufactured by Hitachi Chemical Co., Ltd.) at room temperature for 10 minutes, and washed with water, and then immersed in an electroless copper plating solution (CUST-201, manufactured by Hitachi Chemical Co., Ltd.) at room temperature for 15 minutes, followed by copper sulfate plating. Then, annealing was conducted at 180ºC for 30 minutes to form a conductor layer having a thickness of 20 μm on the surface of the insulating layer. Next, an oxide film on the copper surface of the conductor layer was removed by polishing using a #600 buff, and then an etching resist was formed and an unnecessary portion was etched, and then the etching resist was removed to form a second circuit pattern connected to the first circuit pattern through a via hole.

(7) Further, for forming a multilayer structure, the conductor surface of the second circuit pattern was immersed in an aqueous solution of sodium chlorite: 50 g/l, NaOH: 20 g/l, and sodium triphosphate: 10 g/l at 85ºC for 20 minutes, and washed with water, and then dried at 80ºC for 20 minutes to form an uneven copper oxide surface on the conductor surface of the second circuit pattern.

(8) Furthermore, a series of steps (2) to (7) was repeated to prepare a multilayer wiring board comprising three layers.

Table 1

		Example 2	Comparative Example A
Biphenyl epoxy resin	NC3000S-H	82.8	82.8
Acrylonitrile butadiene rubber particles	XER-91 se-15	5	0
Acrylonitrile butadiene rubber (linear NBR)	XER-31 SK25	0	5
Triazine ring-containing phenolic resin	PHENOLITE EXB-9829 (18%) PHENOLITE LA-7032 (5%)	12.2 0	12.2 0
Phenolic novolak resin Cresol novolak resin	HP-850 KA-1165	0 0	0 0
Phosphorus compound	HCA-HQ	26	26
Inorganic filler	Spherical silica Aluminum hydroxide	40 0	40 0
Imidazole derivative	2PZ-CNS	0.24	0.24
Solvent	Methyl ethyl ketone	55	55

Table 2

Elongation of film	(%)	7	2
Surface roughness after roughening (Rz)	(-)	1～2	>5
Bond strength to plated copper film with low surface roughness	(kN/m)	0.8	0.3
288ºC Soldering heat resistance	(sec)	>60	>60

Consideration of experimental results

From the above table, the multilayer wiring board using the insulating resin composition of the present invention has such properties that a film formed from the insulating resin composition has large elongation, excellent bond strength to plated copper film with low surface roughness, and the surface roughness after being roughened is small, and hence the film formed from the insulating resin composition is advantageous in the refining of wiring, and the insulation reliability and 288ºC soldering heat resistance thereof are excellent.

In contrast, the multilayer wiring boards in Comparative Examples A, which does not essentially contain the insulating resin composition of the present invention, namely component (B), have been illustrated to be poor in elongation of film, in surface roughness after roughening, and in bond strength to plated copper film with low surface roughness.

III. Conclusion

I believe that the above results would indeed be surprising and could never be expected from the description of the cited references. Thus, I do not believe that the present invention is obvious over Tobisawa et al. in view of Japanese Patent No. 2000-256537 and Inagaki et al. along with Japanese Patent No. 2001-247657 and Japanese Patent No. 2002-348353.

IV. The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the matter with which this translation is used.

Date: April 15, 2005 Shin Takanezawa

Shin TAKANEZAWA